

Is a change a change?

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Outline of presentation

- Why is this issue important?
- Treatment in the Good Practice Guidance (IPCC 2003) for LULUCF reporting
- State estimation vs. Change estimation
- Different approaches to change estimation
- The importance of stable definitions and methodology



Why is this issue important?

- In REDD+ the focus is on changes (or indeed changes of changes)
- An inventory design may be good for estimating state but not change (and vice versa)
- Possibilities for major mistakes!
- Need for a certain precision of the change estimates?



Treatment in IPCC's Good Practice Guidance Report (GPG)



Treatment in GPG...

- GPG focuses on annual changes
 - For the LULUCF sector just like for the other sectors
- Builds on Emission = Emission factor * Activity data
- Pre-specified emission factors for lower Tiers
- Suggests two main approaches with regard to advanced (upper Tier) reporting of biomass carbon
 - Growth minus drain
 - Stock change
- Principal advantages and disadvantages with the different methods....



Further about treatment in GPG...

- No precision requirements...!
 - "do the best you can" (and try to avoid bias)
- But the "uncertainty" of the reported figures should be quantified and reported
- Not clear what will be the requirements under REDD+



The GPG offers two main methods for the uncertainty assessment

- Simple error propagation (assuming the basic estimator: Emission = Activity data * Emission factor)
 - Monte Carlo Simulation (which is only a general conceptual approach – not a straight-forward solution)
- => Both approaches "borrowed" from the treatment of other sectors...



However...

- The GPG allows Parties to use other methods – e.g. based on sampling – if national methodology is available
- But not very much guidance is provided for these methods...!



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State estimation vs. Change estimation

- A change estimate can be derived from two subsequent state estimates, but this is seldom the best solution
- What is a 'state' in the context of REDD+
 - Forest area
 - Perhaps separated on different types etc.
 - Carbon stock
 - Perhaps separated on different pools etc.
 - A biodiversity indicator
 - Etc...



Different approaches to state estimation

- Wall-to-wall mapping
 - Typically based on remote sensing
- Stand inventories
- Sample-based approaches
- Combinations



Wall-to-wall mapping

- Good coverage(!)
- Typically poor description of the carbon pools, i.e. low accuracy of pool estimates
- No straightforward link between 'classification accuracy' and the estimates we are interested in
- Typically biased (unknown magnitude of bias)
 - Regards both forest area and carbon stock
 - Bias expected to vary between time points



Stand inventories

- Could be seen as a special case of wall-to-wall mapping... (thus leave for the time being!)



Sample based inventories

- Low spatial coverage (probability sample only)
- Good possibilities to make detailed measurements by pools (if field based) etc.
- Estimates can be obtained with known precision (and are typically non-biased)



Combinations...

- Ideally combinations of different approaches should be sought!
- For example – combinations of remote sensing and field sampling to obtain efficient REDD+ inventories



But back to the simple cases before complicating things further...

- Change estimation based on wall-to-wall mapping
- Change estimation based on sampling



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Change estimation from wall-to-wall mapping

- When a country is completely assessed at two subsequent time points change estimation should be very easy – but...
 - Estimates would typically be biased
 - Size of bias could be expected to vary over time



Example

- Small (systematic) errors in the state estimates may lead to large (systematic) errors for the change estimate
 - Say 2% error for a large pool, e.g. the biomass in Sweden (total about 1000 Mton C: 2% = 20 Mton)
 - Underestimate the first time and overestimate the second time
 - "Change" estimated to 40Mton although nothing happened...(actual about 10 Mton annually)
 - And soils contain twice as much carbon as biomass in boreal ecosystems...



But things can be improved!

- Use images from two time points simultaneously to identify changes
 - Stratify based on change estimates and allocate further efforts differently to different areas
- => If used correctly wall-to-wall approaches have a good potential to identify plausible deforestation areas!!



Change estimation based on sample data

- Independent samples at different time points
 - Permanent plots
- => Which approach is best?

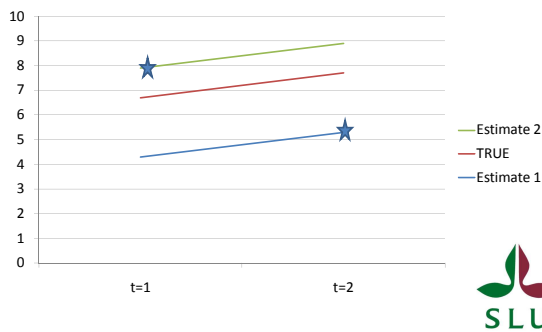


Independent samples

- Simple approach as previous sample locations need not be known
- But the precision of the change estimate will be rather poor... (Variance twice as large as the variance of a state estimate)
 - Even very precise state estimates thus will result in poor change estimates



Why is this (1)?



Why is this (2)?

- In terms of formulas (for independent samples)

Y2: Estimate of state at time point 2

Y1: Estimate of state at time point 1

$$\text{Var}(Y2-Y1) = \text{Var}(Y2) + \text{Var}(Y1)$$

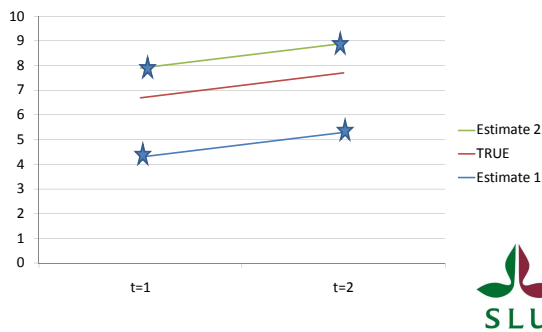


Dependent samples; permanent plots

- Permanent samples are – at least in theory – very efficient for improving the precision of change estimates!
- Same sample locations used at both time point 1 and time point 2



Why is this better (1)?



Why is this better (2)?

- In simple formula terms:

$$\text{Var}(Y_2 - Y_1) = \text{Var}(Y_2) + \text{Var}(Y_1) - 2 \text{Cov}(Y_2, Y_1)$$



Some caution though...

- Use of permanent sample plots must not lead to these plots being treated differently from other areas
 - Histories from countries-not-to-be-mentioned exist
 - Permanent plots stand out like patches of trees in clear-cut landscapes....



Thus...

- Be careful with marking and revealing sample locations if permanent sample plots are used
- Especially in the context of REDD+ where huge money is at stake...!



The importance of known precision

- The GPG approach that precision does not really matter is not applicable to REDD+ (?)
- Precision estimates should accompany the basic change estimates?
- Thus there is a need to assess the precision of the change estimates!



Use of confidence intervals

- A (stochastic) interval that will contain the unknown true value with a certain probability
- Can be rather easily constructed in case the precision of the change estimate can be estimated
- Use lower bounds of confidence intervals rather than the point estimate of change as a basis for REDD+ payment??
 - Would put some pressure on the development of sound MRV programmes

About precision estimation

- Difficult with wall-to-wall approaches, even when combined with field sampling (and classification accuracy in terms of error matrices do not provide a clear message!)
- Straightforward when sampling is applied
 - Although non-sampling errors should also be assessed!
- Often complicated when combined RS-field methods are applied



Precision estimation for methods likely to be used for REDD+ MRV

- Combinations of remote sensing and field survey likely to be used!?
- => Designs tend to be complicated from a statistical point of view
- => Not only sampling errors need to be accounted for, but also model errors (and perhaps measurement errors)



Example from Norway

- The model error part of the total variance in a combined LiDAR and field sampling survey of biomass amounted to 40-90% of the total variance
- (the case of Hedmark with scanning and profiling LiDARs)

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Importance of clear and stable definitions

- Experiences from many processes (e.g. Forest Europe/MCPFE) is that many of the changes observed are indeed due to changed definitions!
- Thus extremely important not to just accept two subsequent state estimates as a basis for the change estimate



Importance of clear and stable methodology

- Just like changed definitions changes in methodology may cause apparent changes (mainly due to measurement errors)
- A couple of examples from Sweden
 - Introduction of new hypsometers lead to increased growth rates over a period of time
 - Unclear methodology for soil sampling (probably) lead to overestimated increases of the carbon pool in litter



Some conclusions

- Change estimation requires different methods compared to state estimation
- Be cautious about just comparing two consecutive state estimates
- A challenge to develop efficient MRV/monitoring schemes
- And a challenge to quantify the precision of the basic estimates!



END



REDD+ decisions – strategic vs. operational decision needs



...covered excellently by Peter Holmgren yesterday!! ☺

- Some details and examples will be added to what Peter presented - and the presentation is shortened to leave some more room for Ron McRoberts



Outline

- General about uses of forest information
- REDD+ information needs
- Brief on the building of MRV capacity



Uses of forest information

- Why gather forest information at all?
 - Use for decisions!
 - Knowledge has a value in itself(?!)!

⇒ Further discussion from the point of view of decision making!



Users of forest information

- Forest owners
- Governmental organisations
- NGO:s and other interest groups
- Decision making bodies to international agreements



Uses by forest owners

- Operational forest management
 - Tactical forest management planning
 - Strategic forest management planning
- ⇒ Very different conditions in different countries; REDD-countries in general would not have much information of this kind



Uses by Governmental organisations

- Information for general forest policy purposes
 - Information for local level governance
 - 'Reporting' to international agreements
- => Typically collected through national forest inventories (which are available in many countries although only few REDD countries)



NGO:s and other interest groups

- General information as a basis for lobbying and similar activities
 - General strategic planning
- => Information typically from national forest inventories



Decision making bodies to international agreements

- Use of information to agree on strategy for reaching the objectives of the agreement
 - Follow-up on commitments by Parties
- => Information typically from national forest inventories



REDD+ Inventories vs National Forest Inventories

- REDD+ MRV/Monitoring likely to be a major driver of national forest assessments
- Thus, consideration should be given to synergies between REDD+ inventories and NFI:s (cf. Peter Holmgren's presentation!!)



Example: Uses of information from the Swedish NFI (~priority order)

- 1) Policy related scenario modeling
- 2) Official statistics (according to legislation)
- 3) Reporting to the UNFCCC and KP (legislation)
- 4) Information for national environmental quality and forest sector objectives
- 5) Periodical in-depth review of forest policy
- 6) Broad spectrum of ad hoc – analyses (government, companies, NGOs)
- 7) Material for research studies
- 8) Reporting to LRTAP (Forest condition)



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Uses of information from the Swedish NFI (2)

- 9) Wall-to-wall mapping every 5th year by combining NFI data and remote sensing
- 10) Data for various international compilations (FRA, Forest Europe, EU, etc.)
- 11) Strategic planning by forest companies
- 12) General environmental monitoring
- 13) Annual berry forecasts
- 14) Contribution to Monitoring required by the Habitats Directive
- 15) Infrastructure for temporary assessments
- 16) Etc...



A general observation

- Monitoring of carbon pools goes hand-in-hand with several other information needs, as it is based on the same type of measurements
- Thus good possibilities to utilise REDD+ as a general driver for provision of solid information for multiple needs...



What forest information would be needed for REDD+

- High-quality country-level estimates to obtain the required change estimates at national level
- But often also a need for local level wall-to-wall-like data to identify 'problem areas' for targeted forest governance measures



Different methods needed?!

- Wall-to-wall-like products needed to support local level forest governance
 - But these data must be cheap (per hectare) and would generally be rather inaccurate
- Other methods needed to come up with the national level change estimates?!
 - Unbiased methods from which precision estimates can be obtained!



Brief on capacity building for MRV

- A huge step to take for most REDD countries
- The 'phased' approach proposed by the Norwegian ministry thus seems very relevant!
- The capacities needed would in many cases go beyond what is required for running advanced NFI:s



Some conclusions

- Good possibilities to combine REDD+ inventories and general national forest assessments
- In many REDD countries there would probably be a need both for methods targeting 'high-quality' national estimates and 'low quality' wall-to-wall information
- A phased approach towards building this capacity would be very relevant!



